The matrix-sized heat spreading module 19 is then mounted on the substrate 20 which includes the matrix of chips 2 mounted in the package sites 21. The matrix-sized heat spreading module 19 is positioned so that the protruding bars 25 are positioned approximately centrally between the rows of mounted chips so that the longitudinal V-shaped grooves 18 and 24 in the upper surface of the heat spreading module 19 are located approximately above the package demarcation lines 22 of the substrate 20.

In this orientation, the thermally conductive adhesive 15 is attached to the upper passive surface of the chips 2 and the insulating adhesive 16 is attached to the upper surface of the re-distribution board 4. The adhesives are then cured so provide a secure connection between the matrix-sized heat spreading module 19 and the chips 2 and redistribution boards 4 of the substrate 20. The solder balls 9 are then attached to the external contact areas 8 on the bottom side of the re-distribution board 4 of each package site 21.

Figure 5 shows the singulation of the individual packages 1 from the matrix package formed by the matrix-sized heat spreading module 19 and the substrate 20 containing nine packages 1 arranged in a 3 by 3 array. The V-shaped groves 18 and 24 in the matrix-sized heat spreading module 19 provide a guide for the saw blade.

The semiconductor packages 1 are then be tested and packaged for transportation to the customer. The semiconductor packages 1 are be mounted on an external printed circuit board.

Claims

1. A semiconductor package (1) comprising:
- a semiconductor chip (2) including an active surface with a plurality of chip contact areas (3),
- a package substrate (4) including a plurality of first contact areas (6) and a plurality of second contact areas (8) on its bottom surface, the chip (2) being mounted on the package substrate (4) with its active surface facing the package substrate (4),
- a plurality of conducting means (5) providing electrical contact between the chip contact areas (3) and the first contact areas (6), and
- a heat spreading means (10) comprising a planar area (11) and at least one protrusion (12), the planar area (11) being attached to the upper surface of the chip (2) and the protrusion (12) being attached to the upper surface of the package substrate (4).

2. A semiconductor package according to claim 1
characterized in that
two protrusions (12) are provided, being located on opposite sides of the chip (2).

3. A semiconductor package according to claim 1 or claim 2
characterized in that
the protrusions (12) are provided along the whole length of two opposing sides of the package substrate (4).

4. A semiconductor package according to one of claims 1 to 3

characterized in that
two opposing sides of the package (1) are open.

5. A semiconductor package according to one of claims 1 to 4
characterized in that
open-ended air tunnels (17) extending from one side to the opposing side of the package (1) are formed between the chip (2), the heat spreading means (10) and the package substrate (4).

6. A semiconductor package according to one of claims 1 to 5
characterized in that
the heat spreading means (10) is attached to the chip (2) by thermally conductive adhesive means (15) and to the package substrate (4) by non-conductive adhesive means (16).

7. A semiconductor package according to one of claims 1 to 6
characterized in that
the chip (2) is mounted to a redistribution board (4) using the flip-chip technique.

8. A semiconductor package according to one of claims 1 to 7
characterized in that
the surfaces of the heat spreading means (10, 19) are at least in part black.

9. A method to assemble a semiconductor package (1) comprising the following steps:
- Providing a module heat spreading means (19) comprising:
- a plurality of sawing grooves (18, 24) on its upper surface, and
- a plurality of grooves (14) and protrusions (25) in its bottom surface,
- Attaching thermally conductive adhesive means (15) to the grooves (14) and non-conductive adhesive means (16) to the protrusions (25) of the module heat spreading means (19),
- Providing a substrate (20) comprising a matrix of package sites (21) arranged in an array each including a chip (2) and a package substrate (4),
- Positioning the module heat spreading means (19) on the substrate (20) so that the protrusions (25) are in contact with the package substrates (4) of the substrate (20) and the groove (14) is connected to the upper passive surface of the chip (2),
- Curing the adhesive means,
- attaching a plurality of external contact means (9) to the contact areas (8) on the bottom surface of the package substrates (4) of the substrate (20),
- Singulating the individual semiconductor packages (1) by using the sawing grooves (18, 24) in the upper surface of the module heat spreading means (19) to guide the path of the saw blade.

10. A method to assemble a semiconductor package (1)
characterized in that
the plurality of chips (2) are mounted using the flip-chip technique to a redistribution

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In Response to the Written Opinion of the International Preliminary Examining Authority of January 19, 2005.

I

New Claims 1 to 18 are hereby submitted.

Claims 1 to 9 remain unchanged.

The claim dependency of claim 10 has been clarified.

Newly submitted claims 11 to 18 are directed to a matrix package which comprises a module heat spreading means and a substrate comprising a plurality of package sites.

The subject matter of claim 11 is disclosed on page 14, lines 25 to 29 and page 12, line 11 to page 14, line 29 of the description.

The subject matter of claim 12 is disclosed on page 14, lines 8 to 10 of the description.

The subject matter of claim 13 is disclosed on page 12, line 9 of the description.

The subject matter of claim 14 is disclosed on page 12, lines 17 to 19 of the description.

The subject matter of claim 15 is disclosed on page 13, lines 19 to 21 of the description.

The subject matter of claim 16 is disclosed on page 13, lines 19 to 23 of the description.

The subject matter of claim 17 is disclosed on page 14, lines 15 to 18 of the description.

The subject matter of claim 18 is disclosed on page 13, lines 23 to 25 of the description.

The applicant notes that claims 9 and 10 are considered new and inventive by the IPEA.

It is requested that the IPEA issues a positive International Preliminary Report on Patentability on the basis of the claims hereby submitted.

II

Independent claim 11 is directed towards a matrix package which comprises a module heat spreading means with a plurality of

protrusions and grooves in its bottom surface and a substrate with a plurality of package sites, each including a semiconductor chip. The protrusions of the module heat spreading means are in contact with the package substrates of the substrate and the grooves are connected with the upper passive surface of the chips.

A matrix package with the features of independent claim 11 is not disclosed by the prior art and independent claim 11 is, therefore, new.

III

The matrix package according to independent claim 11 is also not obvious from the prior art and involves an inventive step.

D3 (US 6 259 154) teaches in Figure 5 that a heat spreader may be provided in the form of a leadframe. However, D3 provides no incentive for the skilled person to apply a heat spreader in matrix form to a substrate including a plurality of packages sites to form a matrix package which is subsequently singulated to form individual packages.

The matrix package according to independent claim 11 is, therefore, not obvious from D3.

D4 (EP 1 172 851) teaches the application of a copper paste to the rear side of a plurality of encapsulated chips. D4 provides the skilled person with no reason to provide a module heat spreading means with a plurality of protrusions and a plurality of grooves in its bottom surface. D4 also provides no incentive for the skilled person to attach such a module heat spreader to a substrate including a plurality of package sites each including a semiconductor chip in order to provide a matrix package.

The matrix package according to independent claim 11 is, therefore, not obvious from D4.

A combination of D3 and D4 also provides no motivation for the skilled person to provide a matrix package which includes a module heat spreading means and a substrate including a plurality of package sites each including a semiconductor chip whereby the module heat spreading means is in contact with both the substrate and the semiconductor chips.

It is also not obvious from D3 and D4 to provide a matrix package which includes a module heat spreading means whereby a plurality of protrusions of a module heat spreading means are in contact with the substrate and a plurality of grooves of the module heat spreading means are connected to the upper surface of the semiconductor chips.

The matrix package according to independent claim 11, is therefore, not obvious from the prior art and involves an inventive step. Independent claim 11, therefore, fulfils Articles 33(3) and 33(1)PCT.

IV

It is hereby requested that a positive International Preliminary Report on Patentability be issued on the basis of the new submitted claims.

Antonia Kern, LL.M.

Enclosures
- new patent claims 1 to 18 (in duplicate)

Claims

1. A semiconductor package (1) comprising:
   - a semiconductor chip (2) including an active surface with a plurality of chip contact areas (3),
   - a package substrate (4) including a plurality of first contact areas (6) and a plurality of second contact areas (8) on its bottom surface, the chip (2) being mounted on the package substrate (4) with its active surface facing the package substrate (4),
   - a plurality of conducting means (5) providing electrical contact between the chip contact areas (3) and the first contact areas (6), and
   - a heat spreading means (10) comprising a planar area (11) and at least one protrusion (12), the planar area (11) being attached to the upper surface of the chip (2) and the protrusion (12) being attached to the upper surface of the package substrate (4).

2. A semiconductor package according to claim 1 characterized in that two protrusions (12) are provided, being located on opposite sides of the chip (2).

3. A semiconductor package according to claim 1 or claim 2 characterized in that the protrusions (12) are provided along the whole length of two opposing sides of the package substrate (4).

4. A semiconductor package according to one of claims 1 to 3 characterized in that two opposing sides of the package (1) are open.

5. A semiconductor package according to one of claims 1 to 4

characterized in that
open-ended air tunnels (17) extending from one side to the opposing side of the package (1) are formed between the chip (2), the heat spreading means (10) and the package substrate (4).

6. A semiconductor package according to one of claims 1 to 5 characterized in that
the heat spreading means (10) is attached to the chip (2) by thermally conductive adhesive means (15) and to the package substrate (4) by non-conductive adhesive means (16).

7. A semiconductor package according to one of claims 1 to 6 characterized in that
the chip (2) is mounted to a redistribution board (4) using the flip-chip technique.

8. A semiconductor package according to one of claims 1 to 7 characterized in that
the surfaces of the heat spreading means (10, 19) are at least in part black.

9. A method to assemble a semiconductor package (1) comprising the following steps:
- Providing a module heat spreading means (19) comprising:
  - a plurality of sawing grooves (18, 24) on its upper surface, and
  - a plurality of grooves (14) and protrusions (25) in its bottom surface,
- Attaching thermally conductive adhesive means (15) to the grooves (14) and non-conductive adhesive means (16)

to the protrusions (25) of the module heat spreading means (19),

- Providing a substrate (20) comprising a matrix of package sites (21) arranged in an array each including a chip (2) and a package substrate (4),
- Positioning the module heat spreading means (19) on the substrate (20) so that the protrusions (25) are in contact with the package substrates (4) of the substrate (20) and the groove (14) is connected to the upper passive surface of the chip (2),
- Curing the adhesive means,
- attaching a plurality of external contact means (9) to the contact areas (8) on the bottom surface of the package substrates (4) of the substrate (20),
- Singulating the individual semiconductor packages (1) by using the sawing grooves (18, 24) in the upper surface of the module heat spreading means (19) to guide the path of the saw blade.

10. A method to assemble a semiconductor package (1) according to claim 9
characterized in that
the plurality of chips (2) are mounted using the flip-chip technique to a redistribution board (4) at each package site (21).

11. Matrix package comprising:

- a module heat spreading means (19) comprising:
  - a plurality of sawing grooves (18, 24) on its upper surface, and
  - a plurality of grooves (14) and protrusions (25) in its bottom surface,

- thermally conductive adhesive means (15) to the grooves (14) and non-conductive adhesive means (16) to the protrusions (25) of the module heat spreading means (19), and
- a substrate (20) comprising a matrix of package sites (21) arranged in an array each including a chip (2) and a package substrate (4),

wherein the module heat spreading means (19) is positioned on the substrate (20) so that the protrusions (25) are in contact with the package substrates (4) of the substrate (20) and the grooves (14) are connected to the upper passive surface of the chips (2).

12. Matrix package according to claim 11
characterized in that
the plurality of protrusions (25) are positioned approximately centrally between rows of chips (2).

13. Matrix package according to claim 11 or claim 12
characterized in that
the plurality of grooves (14) are positioned approximately parallel to each other.

14. Matrix package according to one of claims 11 to 13
characterized in that
the plurality of sawing grooves (18, 24) are arranged in a square grid array.

15. Matrix package according to one of claims 11 to 14
characterized in that
the package sites (21) are arranged in a square grid array.

16. Matrix package according to claim 14 or claim 15 characterized in that
the sawing grooves (18, 24) are arranged in a square grid array which has approximately the same dimensions and orientation as the square grid array of the package sites (21).

17. Matrix package according to one of claims 11 to 16 characterized in that
the module heat spreading means (19) is attached to the chip (2) by thermally conductive adhesive means (15) and to the package substrate (4) by non-conductive adhesive means (16).

18. Matrix package according to one of claims 11 to 17 characterized in that
the chips (2) are mounted on the package sites (21) using a flip-chip technique.